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THE SURGERY OF THE HAND

BEING THE

CARPENTER LECTURESHIP ADDRESS

BEFORE

THE NEW YORK ACADEMY OF MEDICINE

BY

ROBERT ABBE, M. D.

OF NEW YORK

NOVEMBER TWENTIETH

1893

PUBLISHED BY THE ACADEMY

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"*I give and bequeath five thousand dollars to The New York Academy of Medicine, with which to found a lectureship to be known as The Carpenter Lectureship, to be paid to the trustees of The New York Academy of Medicine, to expend the interest thereon annually for one medical lecture.*"

[Extract from the will of WESLEY M. CARPENTER, M. D.]

THE SURGERY OF THE HAND.*

BY

ROBERT ABBE, M. D.

MY interest in the surgery of the hand was first stimulated in 1875, when, in assisting Dr. Weir in a resection of the wrist, I read Liston's enthusiastic and scientific article upon that subject, in which he spoke of the marvelous mechanical perfection of this particular joint.

No one can contemplate the perfect hand without wonderment and admiration, but, like the use of our eyes and ears, we think little about it unless its use is impaired.

Many of the surgical troubles that occur to the hand—fractures, sprains, etc.—have their counterpart elsewhere in the body, and we shall not consider these this evening. Nevertheless, there is great need of wider knowledge by general practitioners of the importance and gravity of such common troubles as poisoned cuts and pin pricks of the thumb and little finger, the suppurative inflammation from which spreads along the tendon sheaths to the common bursa of all the flexor tendons above and below the wrist. This causes permanent loss of usefulness of more hands than are destroyed by all other causes together. A bad result can only be prevented by quick use of the knife and antiseptics.

Of very great interest among hand troubles, of which I find a widespread ignorance among physicians, is one which has attracted my attention specially during the last twelve or fifteen years, and which is illustrated by some of the

* The Wesley M. Carpenter lecture, delivered before the New York Academy of Medicine, November 20, 1893.

charts here displayed—namely, Dupuytren's contraction of the palmar fascia.

The general surgical aspect of the malady has received most careful consideration by Mr. William Adams, whose very large experience in this particular disease has rendered him the first authority upon the subject, and it is needless for me to more than refer to the second edition of his valuable work, issued last year, for most of the essential points upon it. There are some points, however, that have come within the scope of my experience on which my judgment differs somewhat from his, and to these I will direct especial attention.

In two previous articles written by me upon this subject, first in 1884 (see the *New York Medical Journal*, April 19th and 26th, and later in the *Medical Record*, March 3, 1888), I proposed a theory of its causation which was entirely at variance with the gouty theory generally accepted and since reiterated by Mr. Adams.

Reasoning from numerous cases of the neuroses and neuralgias which the patients with Dupuytren's contraction were often subject to, I satisfied my own mind, at least, that there was a strong probability that traumatism of the nerve ends in the palm, reflected to the central nervous system and thence to the opposite hand, would perfectly account for the course of events as seen in this class of cases.

Mr. Adams and Dr. Keen, of Philadelphia, have both lingered over the theory of its gouty origin, strongly impressed by certain phases of rheumatic development in the affected hands, and by the occasional hereditary tendency of the disease.

My own experience, based at that time upon about twenty-five private cases and fifteen additional public hospital cases, led me to discard the gouty theory because of the almost universal absence of gouty inheritance of the patients who came under my observation. It was not rare to find a history of rheumatism in the families of the patients, but extremely rare to find a case of typical gout.

In both my papers I detailed many cases of striking neuralgias and neuroses incident to the course of the contracted fingers. It is curious to me that Mr. Adams is able

to say that in the course of his experience in England he has never met with any such cases of painful neuralgias and neurotic affections extending to the shoulders and

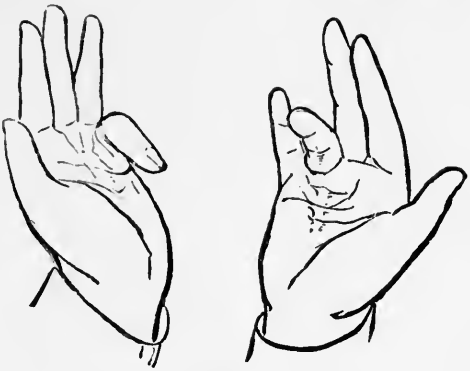

Fig. 1.

spine. He naïvely remarks that while I have "asserted that in English society gout is an almost universal legacy, and in America typical gout comparatively rare, but rheumatism more common," he "can not help thinking that distressingly painful neuralgias and various neurotic affec-

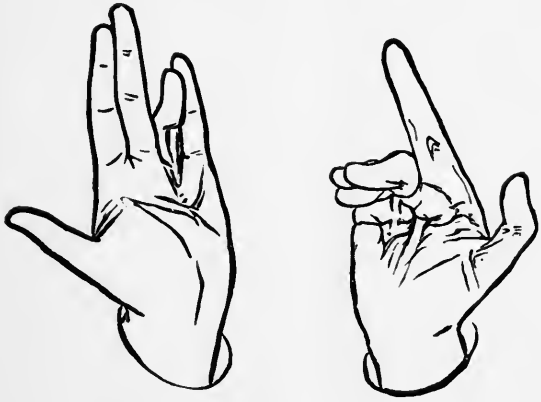

Fig. 2.

tions are more common in America than in England." My subsequent experience, based on an additional twenty-five cases in private practice during the last four years, into the histories of which I have been able to search, leads me further away than ever from the presumption of gouty origin.

A few striking cases of neuralgias have occurred among these, but none so pronounced as several that are quoted in my first two papers. Several cases in my experience have resulted from distinct traumatism and scars.

I shall briefly recount a few typical cases to illustrate my position, and I shall be greatly surprised if the future experience of others having their attention called to these associated symptoms will not also reveal many that have been overlooked by them. Except for the typical gouty manifestations in the feet and hands, it is easy to say gout is the cause of many clinical symptoms and hard to prove it in these contracted finger cases. The trouble is certainly absolutely rebellious to antarthritic remedies, and does not come generally in gouty subjects. There is no exact analogy to this palmar contraction in gouty manifestations elsewhere. Tophi are never seen in these palmar contractions, no matter how long they may have existed.

The theory of gout, so far as I can see, is purely an assumption. On the other hand, the disease affects a member whose tissues are highly endowed with nerve ends. It is associated with pure neuralgias. Its neuralgias are often relieved as if by magic by an operation on the bands. It prefers to attack the ring and little fingers, the most subject to bruises.

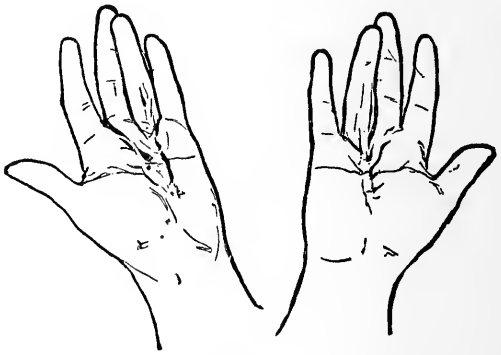

FIG. 3.

"The joints of these hands are generally in a healthy condition," says Mr. Adams. I myself have but once seen a truly gouty knuckle in these patients. The fact that many patients can refer the contracting band to injury and

sometimes show scars is an argument in favor of this probable causation in all cases—*i. e.*, traumatism. Such cases as the following are not uncommon:

Ten years ago a patient was precipitated down an elevator, hanging on the chain for two stories. He did not experience any special bruise, except that the skin was slightly cut on the left hand and torn a little on the right. Three or four years later the ring finger in each was drawn down a little in the palm, the left soon touching it.

Several of my patients attributed their contractions to the driving of horses; others to boat-rowing and other injuries. One typical bruise may be illustrated as follows:

Mr. O., aged fifty-three years, a most intelligent observer of his family history, denies rheumatism or gout on either side among his ancestors, and is conversant with his family history for several generations back. Ten years before this trouble began he used the palm of his right hand, on the little-finger side, to knock up the lever of a heavy safe door, and has kept up the practice ever since. In two or three years the contraction began in the little finger of that hand, and it has progressed ever since. Dull aching was noticed in the morning at the seat of trouble. Two years later the knuckles of all his joints of the affected hand began to act as if subject to subacute rheumatism, and two years ago the left-hand knuckles of the corresponding fingers became red, swollen, and showed some disposition to ache. This phase of rheumatism, as pointed out and fully illustrated in my first paper, is a distinct neurosis.*

* Of other cases attributable to accidents I would mention that of Mr. P. K., who, climbing a ladder, had a spiked piece of frozen mortar clinging to a round pierce his palm over the ring finger. The callus never went away entirely. Typical Dupuytren contraction ensued. After two or three years progressive weakness of the ulnar fingers ensued, diminishing his grip and associated with writer's cramp.

In another, a civil engineer had a long series of stakes to put into the ground, and pressed them hard with his palm. Next day he had a sore palm, and dates his contraction from that.

I have seen but one case where Dupuytren contraction was secondary to neuritis.

A man of thirty-seven years had his forearm caught between two cars, so as to jam the elbow at one end and the palm at the other. Subsequently he had pain of ulnar and progressive partial paresis, with atrophy of the thenar eminence and development of true Dupuytren contraction of the fascia over the ring and little fingers, which I dissected out with much relief, but ulnar neuralgia with swollen nerve, easily felt at the elbow, continued as long as he was under observation.

An interesting illustration of neurosis was shown by Mr. W., who had a sharp band developed in the middle finger ten years before. Some contraction had also developed in the left palm later. The patient emphasized a curious neurosis that had been present in the right arm most of the time, especially on awakening and for some time afterward—*i. e.*, a sense of great increase in size. as if the shoulder and arm were distended to twice their natural size, giving a strange and unnatural feeling; occasionally he has pain about the left shoulder. In 1885 I operated, dissecting out the band throughout the palm. There were three purplish nodular swellings along this cord. It was done under cocaine and painless. The finger came out perfectly straight. Two years and a half later the hand was absolutely free from contraction; the fingers could be even bent backward a little; the cicatrix was soft and white; he had had no pain for two years. The neurosis of his arm entirely disappeared. Moreover, the left-hand bands, that had not been operated on, became softened a little and gave no trouble.

A second case was of much interest. Dr. W., a distinguished physician of this city, with absolutely no inheritance of rheumatism or gout, attributes his contractions to the use of the rough head of a cane. His father also had had the same trouble. In his right hand, for fourteen years, he had a contracted ring finger, bending down well toward the palm. Recently he had suffered from brachial neuralgia and deltoid and

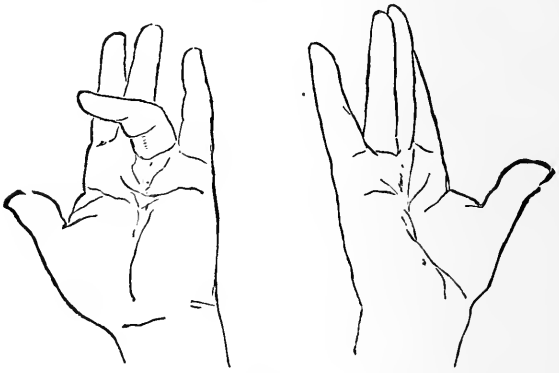

Fig. 4.

cervical pains, like lumbago, on the affected side. His left hand began, seven years after the right, at the same point precisely. There was a burning sensation in the palm, and commencing neuralgia of his arm. The right hand showed bands running to

the little and ring fingers; the left, bands, faintly outlined, going to the same fingers.

This illustrates the almost universal fact that both hands are very rarely affected at the same time; that one follows the other at an interval even of years, and that the corresponding fingers on the ulnar or radial side—usually the ulnar—take much the same position in both hands, as is well illustrated in Figs. 4 and 5. These points are an argument in favor of the reflex action of one hand through a corresponding nerve to the opposite hand.

There was more or less swelling of the knuckles of both hands, resembling rheumatism. In 1889 I cut out the band in the right-hand finger, and made two transverse cuts to release the little finger. Six months later Dr. W. came to see about having the left hand cut, reporting that the operation on the right hand had been most satisfactory; that he had since had but little pain in the shoulder, and could put his arm forward without inducing pain. The left hand had been recently giving neuralgia of the ulnar side of the forearm and numbness of the little finger. Two years later he made the following graphic and convincing narrative of his pains which had been present at first:

1. Has had no knuckle swelling or suggestion of rheumatism.
2. There has been no pain at all in the right hand.

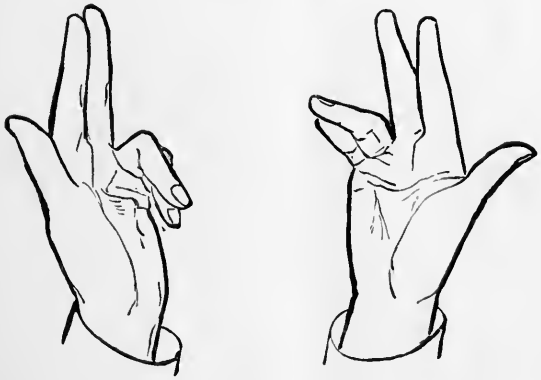

Fig. 5.

3. The neuralgia and pain in the right cervical region have not returned.
4. Until lately there has been no pain whatever in the right shoulder.

5. The burning of the left palm disappeared after the operation on the right hand, and has never returned.

6. The pain that was slight but present in the left arm before two years ago, no operation having been done here, has increased so as to be unpleasant, resembling sciatic neuralgia, not limited to any muscle, but distributed in the back of the arm and the ulnar side of the forearm. The arm aches when raised to the horizontal, and has an unnatural feeling of heaviness.

7. Altogether, the left has been the bad arm this year, while before the operation on the right, that one was the chief seat of trouble.

I now operated upon the left hand, and there has since been absolutely no return of trouble. The right hand illustrated how well the excision method of operation had done on the ring finger. The cicatrix was fine and free from recontraction. The little finger on which crosscuts were employed recontracted somewhat.

A. B. was a car conductor, whose left index finger had drawn down into the palm and interfered seriously with his work. He attributed it to former hard plowing and hoeing. He had neuralgic rheumatism across the shoulders, so persistent that he got his coat on with difficulty. I made five transverse cuts and released the fingers perfectly. Two months later he reported himself absolutely well and free from pain, having worked since ten days after the operation.

In 1888 I operated on A. C., aged fifty-three years, for Dupuytren's contraction, which he attributed to a strain while turning a stopcock firmly some years before, when he heard a snap as if something was breaking in his palm. The palm puffed up, and then the swelling slowly disappeared, the palmar contraction following fifteen months afterward. The left showed a knot of contraction in identically the same place as the opposite. Pain had commenced eight months before I saw him—a deep-seated neuralgic pain which made him think he had rheumatism. After the operation his pain disappeared.

Regarding Methods of Operation. — Following Mr. Adams's urgent advice, the tendency has been to resort to the subcutaneous division of the bands at several points in the palm. This method was uniformly resorted to by me in the early years of my experience. Finding many recontractions, and believing that the absolute safety of good surgical work enabled one to cut out and get permanently rid of the offending band of diseased fascia, I have during the last few years resorted in most cases to excision. The

results have been better than by subcutaneous division in my hands. The operative procedure is thorough, safe, and exact. It can be done painlessly and bloodlessly with cocaine anæsthesia combined with Esmarch's bandage, and leaves soft linear scars.

The relative merits of excision and subcutaneous division have been illustrated by some of my cases in whom both methods were tried; for instance:

A lawyer from Indiana, whom I saw in 1887, had his right middle finger drawn down for twelve years, and the left became involved five years later. Three years before I saw him he had had a cross-incision of the right-hand band in the palm which brought the fingers straight, and it was useful for a time, though it afterward required another operation. This time the subcutaneous incisions were made by an able surgeon. It soon began to draw down again when the splint was removed. Six months later the left hand was operated upon by subcutaneous incisions. Contraction had been progressive ever since these wounds were healed. I operated by linear extirpation of the right-hand band, not exposing the tendon or nerves. On the left hand the cicatricial and fascial contractions had matted the tissues of the palms. I made cross sections at seven points, making lozenge-shaped cuts when the finger was straightened. This left the finger free. The result was all that could be desired in both hands at the time. Three years later the left hand had undergone recontraction of the ring finger, which had been crosscut, while the right, where excision of the banp had been made, was straight and supple.

This proved incontrovertibly to my mind the superiority of excision. I then excised the band that had reformed in the left hand, which had become more prominent, and was able to release the fingers perfectly. Two years later a perfect result was shown from both operations. Five years had thus elapsed without recontraction of the first excised bands.

A tumefied condition of the fascial band often precedes the contracted stage, and can be readily cut across by open incision, after which the wound melts away invariably, though in a year or two the band is apt to recontract through the scar.

This dissolving of the tumefied cord when severed is as if the nerve filaments being cut, the path of irritation is

broken, and the products of inflammation are quickly absorbed.

I now give decided preference to the cutting out of contracted bands, which, though a somewhat delicate operation to do, is thorough and enduring in its results. Nowhere is the use of cocaine more satisfactory. Yet I have found, as has been observed also by others, that, from some yet unexplained cause, cocaine will occasionally yield very slight anæsthesia. I have seen this on two or three occasions only. A fine hypodermic needle must be used, and a two-per-cent. solution of cocaine. Not more than ten or twelve drops will be needed if properly placed in the derma at points one third of an inch apart along the proposed incision over the band. There will always be found a layer of fat between the tendon sheath and fascia. Interrupted fine silk sutures should adapt the cut edges exactly.

A narrow strip of cleansed gutta percha or protective is laid along the cut and small compresses of damp gauze laid an inch deep over this. Over all a square of thin gutta-percha tissue will keep the dressing damp and favor the drainage of the capillary oozing from the cut. A firm bandage should be applied before the Esmarch bandage is taken off.

The completed operation and dressing is done within twenty minutes, which I have found to be about the limit of time that most patients can comfortably bear a snug Esmarch bandage.

The first dressing should be changed in twenty-four hours. The second on the fourth day, when stitches may be removed.

Contrary to the custom of Mr. Adams, who puts on a straight splint at once, I have found it better to let the fingers assume a comfortably correct position, under a dressing without splint (which will often induce pain by overstretching), and I put on no splint until a week has gone by and the parts are healed.

Although I have records in my private note book of fifty cases of Dupuytren contraction, representing about that number of operations, I have never seen a case of suppuration after operation, although most of those of the last four years have been excised.

The paralytic and inflammatory deformities of the hand —so-called "*main en griff*"—are to be carefully distinguished from Dupuytren contraction before operation, the tendons in such cases being contracted but buried in the flat palm and not raised like the bands of the latter.

Contractions simulating Dupuytren's.—Twice I have seen children with the little and ring fingers of each hand drawn down to the palm, looking like a Dupuytren's contraction, but purely of reflex origin. One case, seen five years ago, has lately been reported by the child's father as almost entirely straightened with time.

Another quite frequent deformity resembling a Dupuytren's contraction is seen in the little finger curved by reason of a congenitally short skin on its palmar side preventing its being straightened out as its neighbors. On manipulating it, one readily feels that there is no band under the skin.

FIG. 6.

I have seen one such finger with a double twist giving it a spiral curve toward its neighbor.

The palm is occasionally traversed by bands of congenitally short skin underlaid by somewhat limiting bands—not, however, of palmar fascia. This is well illustrated by the annexed Fig. 6, showing the hand of a young lady whose piano playing was limited by inability to stretch the fingers far enough. This was greatly improved by several subcutaneous cuts.

To completely remedy these defects is not possible, but much may be done toward that end by crosscuts of the short skin, allowing the lozenge-shaped gaps to granulate and be stretched later. This I have done in several cases and acquired a soft scar.

Neuroses of the Hand.—These belong mostly to the province of the neurologist, but some, being of surgical interest, may be mentioned:

An intelligent lady of forty-five years ran a threaded needle, head first, into the middle of her middle finger on its palmar side. She experienced not much pain, but an entirely disproportionate shock to her nervous system. She was bewildered and could not collect her thoughts for a few minutes. The needle being tightly stuck in, she had to use force and pulled it with her teeth. She observed a stringy fiber came with it, which her doctor said was a nerve. She walked home an hour later, but was overcome by bewildered feelings. She lost her memory and found herself leaning against a house some distance away.

Her nervousness continued, and on the second night she awoke like a mad person with intense pain and a swollen finger. Suppuration, erysipelas, and pyæmia followed. One night she awoke with aphasia and left hemiplegia, and did not recover speech for six weeks.

When convalescing she had spasmodic contraction of the face, arms, and legs during dressing of the hand. The healthy side became hyperæsthetic. It was three months from the accident before she began to walk. She still mixed her words, and when I saw her two years later she was in an overwrought nervous state with a hand unfit for manual work. Memory, which had always been good before the accident, was still capricious. For example, she would forget in ten minutes all I had asked and said to her, but a week later it would recur clearly to her. She used wrong words and was not at the time conscious of it, but in half a minute realized she had spoken falsely.

When she began to speak after her sudden aphasia she had to learn over again the use of most words and the meaning of many. She still mixed up words in a sentence.

Such is the history of a striking case of shock to the central nervous system from a slight nerve injury of the hand.

A boy was brought to me with the ring and middle fingers of his hand half closed into his palm. There was no Dupuytren contraction of the fascia. He had been playing at jumping over posts some years before and bent down the middle fingers, straining the knuckles, which enlarged, with subsequently some rigidity. Later the same pain and stiffness were reflected to the opposite hand with occasional neuralgia of the shoulders. He had flexor cramps when gripping a hammer, hoe, or rake.

Several cases narrated further on represent also neuroses from traumatisms.

Incidentally one may meet these conditions with hammer palsy, artisan's cramp, or musician's cramps, many of which I have seen. Among them, one more striking than another is that of a young lady, a violinist, who, being in perfect health, was assigned by her teacher to play a concerto in public. Time being limited, she practiced one staccato movement, which was new to her, for two hours in succession, at the end of which time she broke down completely. Her hand was useless. There was complete muscular or nerve exhaustion. She was unable to write or use her violin. Later she had insufficiency of the eye muscles, requiring prisms, and flat foot, requiring her to use crutches and have a metal arch put into her shoe.

Seven years have passed and she has never regained nervous force enough to control her violin bow, or to write more than ten minutes without her hand giving out.

These few illustrative cases, chosen from many, suffice to show the intimate relation between many cases of hand troubles involving nerve ends and widespread disturbances of the system.

Tumors.—Of more special surgical interest are tumors of the hand and fingers, of which from many I will narrate three or four of special interest. It is in the hand that the smallest tumors are often the most troublesome, because conspicuous. I have notes of one little tumor as large as a small pea on the end of the thumb in a woman who had been prevented from sewing by it, owing to pain on pressure with further pain in the arm. It was in and below the deep layer of the derma, and on being dissected out proved to be a purplish-looking spindle-celled sarcoma, denominated by Paget painful subcutaneous sarcoma. A second and larger one in another patient grew in the center of the palm.

I have had four such tumors of the hand—two above the wrist—so painful on being struck that they caused the hand to drop anything that the patient might be carrying.

One which I dissected out ten years ago was a typical sarcoma, and had not recurred at the end of eight years. Nor have the others returned as far as I know. Another tumor at the base of the index was as large as a walnut,

was soft enough to give a striking sense of fluctuation, but proved to be a pure fibroma with soft stroma.

In the palm one occasionally sees small hernias of the sheaths of the tendons buried in the fat of the palm, little cysts filled with transparent jelly and with very small connection with the sheath. These are like weeping sinews, so common on the back of the wrist, but can not be dissipated by a blow. I have seen them disappear without treatment, but this is so rare that one should dissect them out if they give trouble. Such a one I recently dissected out from the fat of the palm at the root of the ring finger, where it had given annoyance.

Hypertrophy of the Fingers. — Hypertrophy of the knuckles, very well described in Tillmann's *Surgery* (Leipsic, 1892), is an epiphysial hyperostosis, with elongation as well as broadening of the bones of some of the fingers. Others on the same hand often remain normal. The drawings (Fig 7) are taken from a photograph of a lad sent to

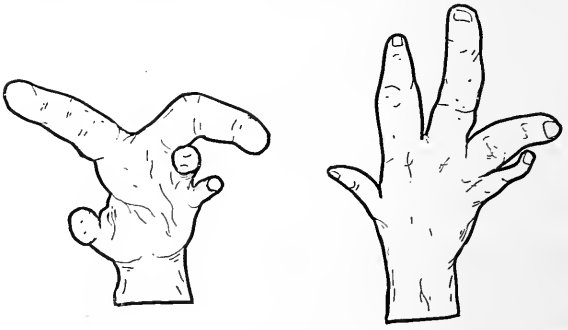

Fig. 7.

me from a physician in Maine. The great toe and the second toe showed the same extraordinary enlargement.

Trigger Finger.—I fancy it may be such a growth that causes the curious trouble denominated (trigger) "snap-finger," of which I reported five cases, with illustrations, some years since (see Figs. 8, 9, 10, and 11, here published by permission of the *Medical News*, in which they originally appeared). The patient closes all his fingers in the palm, and on opening them finds that one will stay shut and can only be opened by using the other hand to effect it, when it flies open like a knifeblade with a snap.

It is said to be due to a tumefied condition of a point of the tendon, making a bulbous enlargement that catches under the ligament at the base of the finger. One such case is reported as being capable of dissection and relief. In my cases there was no perceptible swelling and all recovered after a few months, part of which time they were kept on a little wood splint

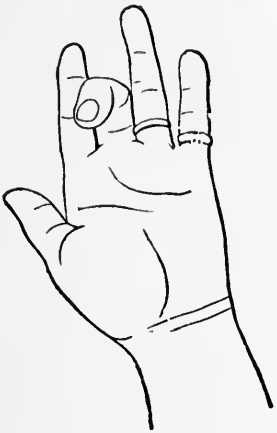

Fig. 8.

Fig. 9.

with pad pressure, which prevented friction and irritation.

Of particular importance I will mention two deformities of the end joint of the fingers, happening from slight accident, which need the earliest surgical care and admit of most particular work.

Drop Finger.—Two cases illustrate what I would call "drop finger." Both happened from apparently insignificant causes:

In one, a lady was taking off a stocking, and pushing it down the side of her leg with the tips of her fingers, suddenly found the end joint of her ring finger had given way and hung at right angles to the finger, powerless. With her other hand she could straighten it, but was unable to support it. It appeared to have nothing but skin over the joint to hold it up. The extensor tendon, where it thins out disproportionally to its size above,

had torn away from its delicate attachment to the base of the last joint.

In a fortnight the joint became red and tender; a sharp, shooting pain extended from the knuckle to the wrist, forearm,

Fig. 10.

arm, shoulder, and back of the neck. It was often severe enough to make her wholly sick.

She volunteered the statement that a fortnight after the accident the same joint of the other hand pained her when using it. This pain lingered six months after, when I first saw her. The injured hand was quite disabled on that account. It was tender if touched, ached if used, and if struck by mishap it "made her sick all over."

It was now impossible to straighten it on account of the inflammatory sealing up of the torn capsule. I therefore resected the joint and made a solid, straight, and useful finger. When it was healed she was free from pain. I have to-day seen her, more than five years since operation, and she has not since had pain and uses the finger as if it were never hurt.

The second case in which I operated was on a prominent architect, whose ring finger dropped useless at the last joint from the slight pressure of his finger tips pushing across a paper from off which he was brushing some crumbs.

I operated two weeks later, when his physician found himself unable to keep the joint straight, even using a splint. Through a linear cut on the back of the knuckle I sutured the

torn end of the tendon to the periosteum of the base of the last joint. The result four years after has been most admirable.

Baseball Finger.—The reverse deformity to the above is now very commonly seen in baseball players. The last joint is violently dislocated backward and can not be replaced, on account of the flexor tendons wrapping themselves round the head of the proximal bone of the joint, which also slips out through a buttonhole of the capsule. This accident makes a permanent bayonet deformity. It is very apt to be compounded by laceration of the skin at the flexure crease. In three such

Fig. 11.

Fig. 12.

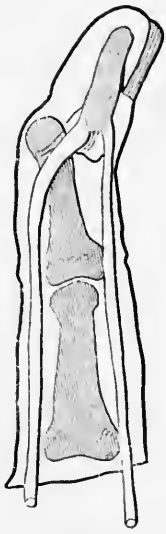

Fig. 13.

cases I have been able to restore the parts perfectly through incision, though in one I had to resect the head of the bone and make a stiff joint.

Burn Scars.—Some of the worst deformities of the hand one ever sees are produced by burns. These have heretofore been the *bête noire* of the surgeon. Now it is possible, thanks to Professor Thiersch, to restore many of the worst cases to usefulness by skin grafting.

I will mention only a few of the bad cases I have had.

Two almost similar in deformity were produced in girls working in laundries where ironing mangles were used, the upper cylinder of which is kept hot.

Their hands, being drawn under the roller, were burned

to the bone from the knuckles to the wrist, and the resulting slough, including tendons, left a scar which drew the hand directly back upon the wrist.

Dissecting out such massive scars, one brings the fingers as nearly straight as possible and makes Thiersch grafts over the parts exposed. Two such cases are illustrated on the charts.

A unique accident brought a young man to me with broad ulcerated surfaces around each wrist, threatening him with ultimate loss of wrist action. He had been cleaning a pair of gloves with benzene and had on celluloid cuffs. The former ignited and set fire to his cuffs, which burned like tinder. He made frantic efforts to get them off, but they were stiff and only burned him worse for handling, so that they practically burned themselves off *in situ*.

I planted Thiersch grafts on both wrists with the happiest result. All scars were perfectly supple six months afterward.

Indeed, I may say that these grafts do not show the contracting tendency that the scar tissue does, and are adapted to burn cicatrices perfectly. Indeed, I have cov-

Fig. 14.

Fig. 15.

ered the entire arm from the back of the hand to above the elbow with them, and had fine supple skin three years after.

Webbed Fingers. — There is one finger deformity to which this method, therefore, specially applies—namely,

webbed fingers. All that is needful is to split the web and dissect out any tough part well down between the fingers, then put a long strip of Thiersch graft up one side and down the other, retaining it by gutta-percha tissue at the flexion.

Such a case of all the fingers I put up in a permanent dressing at the time of operation and removed at three weeks, to find the parts perfectly healed.

Conservative Surgery.—I will not weary you with enumerating further the many hand troubles which always elicit the surgeon's pity as well as skill, but will venture afield into a novel inquiry that has occupied some of my thoughts of late.

Last spring a well-to-do man from the West was sent to me with both hands gone above the wrists. A dynamite cartridge, with which he had been expecting to do some fishing by a method of which the law takes cognizance in some States, had exploded in his hands and amputation had been required. With Western energy he had come East to see if there was not some one who could graft a new hand upon his arm. He said he was sure he could persuade the Territorial Governor to release a convict who would sacrifice a hand for remuneration, which he himself was ready to pay. I could but smile at the Munchausen tale such a deed would make, and took his address, promising, if ever it became possible, I would communicate with him.

Not long after a man came to me from New Jersey who had had a buzz saw plow through his hand from the back, severing all the fingers and the thumb through their metacarpal knuckles, cutting obliquely toward the wrist, and leaving the hand hanging by the skin at the line of the palmar arch. Every tendon—both extensors and flexors, except the flexor of the thumb—was cut across.

It seemed inevitable the parts must be sacrificed, but I decided to see how much could be done, and spent three hours and a half trimming the torn tendons and muscles, resecting the disrupted joints, and suturing the whole. I can hardly believe that the skin and some soft parts alone nourished the fingers, but that one or more of the digital arteries were probably spared, though I did not discover them.

The little finger was the only one that became gangrenous, the thumb and three fingers showing good vitality.

I saw the man a few days since after six months. He now uses his hand for all work, and has a little flexion of the fingers

and slight independent flexion of the end joints. The thumb grasps tightly against all the fingers and he writes almost as well as ever.

In view of the fact that surgeons have replaced a finger, an end of a nose, and small parts of flesh under favorable conditions, I asked myself *why not* a major part, such as a hand or a leg? Is it our inability to nourish the part, or to innervate it, or to unite tendons, muscles, or bone? The latter surely gives no trouble. Tendons are sutured every day, and under favorable circumstances their function is restored. Nerves are frequently sutured and functional restoration is often recorded.

Is it impossible to restore an arterial supply once cut off? Veins are frequently cut and sutured, and perform perfectly afterward. Is there no way to restore an artery?

The question seems to narrow itself down to nourishing a limb in order to restore it.

Experiments.—During the summer I made a few experiments at the Carnegie Laboratory, with the assistance of Dr. Theodore Dunham, and through the kindness of Professor E. K. Dunham.

To see whether a thin glass tube would be tolerated in a steriiized state within an artery, I made a number of half inch pieces to suit the caliber of a dog's femoral, constricted them very slightly to an hour glass shape, and smoothed their ends by heat, so that no surface roughness should induce clotting. Cutting the femorals across, I tied each end over the tube by a fine silk thread, and tied the thread ends together. Primary union resulted, and the dog's legs are as good as ever.

I feared, however, that the artery might have become blocked in this case, and the collateral circulation had nourished the limb. I therefore cut one out to see, and tied the femoral above and below. The tube was free in a dilated end of the artery, and slow endarteritis had sealed it below. Whether this would necessarily occur I decided to see by putting a tube in the aorta, where it seems as if collateral circulation could not save the limbs. I chose a cat, whose abdomen I opened and whose aorta I cut across, clamping lightly above and below. Into this I tied an inch of very thin glass tube sterilized by boiling, and filled with

water just before inserting into the lower end, so as not to have air emboli. The cat made a perfect recovery, and after four months I show you him to-night, fat and strong, with a glass tube in his aorta.

I afterward tried the same experiment on a large sheep, whose aorta is thicker-walled and larger. Unfortunately, I clamped the aorta so tightly by a broad pedicle clamp that I crushed the inner wall, and at autopsy, two days afterward, the site of clamping was blocked by adhesive clot.

Two days ago Dr. Dunham and Dr. Cushman repeated the experiment on a large dog, and he has thus far been well.

Four months ago I added one step more to the experiments. I dissected out the brachial artery and vein near the axilla of a dog's fore limb, and, holding these apart, amputated the limb through the shoulder muscles and sawed through the bone, leaving the limb attached only by the vessels. I then sutured the bone with a silver wire and the nerves with fine silk. Each muscle I sutured by itself with catgut, making a separate series of continuous suturing of the fascia lata and skin.

The leg was then enveloped in sterilized dressing, a liberal use of iodoform gauze being the essential part. Over all, cotton and a plaster jacket were placed, leaving him three legs to walk on. A small drain of the axilla was removed at the first dressing and a permanent dressing applied, which remained two months. The dog's leg united perfectly, and he is here to show how well he can use it.

Thus we see that, if in an amputated limb an artery can be left, the limb will survive the division of everything else. And, further, it may be asserted that, if an arterial supply can be restored to a completely amputated limb, *that* limb also may be grafted back to its original or a corresponding stump.

Up to the present I do not feel that we have incontrovertibly proved that arterial continuity can be restored by a glass tube in all cases. But it is not impossible that, if slow proliferating endarteritis shuts up the main artery in a few weeks, the anastomosis through the soft cicatrix of

vascular muscle and skin may be able, by the recuperative power of Nature, to take up the nutrition and ultimately carry it on.

The final experiment of the series which I set out to make—namely, the complete amputation of an animal's limb and its restoration—requires preparation, assistance, and time, so that I have not been able to complete it within the period preceding the time appointed to read this paper. I shall therefore report at another date to the Academy such facts as may be further developed.

Some one may ask, Where is the supply of limbs to come from should it ever be possible to graft a leg or an arm? I may say that I doubt not that a limb crushed, let us say, at the thigh or shoulder, requiring amputation, would admit of Esmarch's bandage being applied to expel its blood and of being used after amputation. It should be just as viable as any limb which we keep bloodless for hours under Esmarch's bandage, and have no trouble with when blood is let into it. Why not another man's blood as well as its owner's?

I do not expect that this vision of surgical possibilities will be realized soon, nor do I think enoughhas been proved to warrant much hope, but I feel that experiment in that direction will yield much surgical instruction.

The tolerance of sterilized glass tubes in the larger arteries admits of further application than has been hinted at in this paper.

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